IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Chien-Jen Chen et al.
Application No.	:	09/848,725
Confirmation No.	:	8417
Filed	:	May 4, 2001
For	:	RAMAN AMPLIFIER SYSTEMS WITH DIAGNOSTIC CAPABILITIES
Group Art Unit	:	3663
Examiner	:	Stephen C. Cunningham

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RULE 132 DECLARATION

I, Chien-Jen Chen, solemnly state and declare as follows:

1. I am a citizen of the United States of America and reside at 21451 Elm Court, Cupertino, California 95014.

2. I graduated from National Taiwan University in 1983 and received a Bachelor of Science degree in Electrical Engineering.

3. I received a Ph.D. degree from the University of Maryland in 1993.

4. I have worked at Onetta, Inc. since April 2000 and

hold a position of Principle Engineer.

5. I have been active in the field of optical communications since 1988.

6. I am a co-inventor of the invention described and claimed in my U.S. patent application No. 09/848,725, filed May 4, 2001.

7. I have reviewed the Office Action dated April 22, 2004 in connection with my patent application and cited prior art references including Ghera U.S. patent 6,433,922 and Park U.S. patent 6,452,716.

8. I have reviewed claims 1 and 2 in the accompanying Reply to Office Action for my patent application and have compared the arrangement defined by those claims to Ghera and Park.

9. Claims 1 and 2 are directed to an optical amplifier equipment arrangement in accordance with my invention that has a two-wavelength Raman pump that makes optical time domain reflectometry (OTDR) measurements. With this arrangement, Raman pump light at a first wavelength creates Raman gain for Raman pump light at a second wavelength. The first wavelength of Raman pump light is modulated while the second wavelength of Raman pump light is pulsed at a higher frequency. The power of the first and second Raman pump light signals is not reduced to zero as measurements are made. The arrangement has a circulator

that directs the Raman pump light into transmission fiber through a first wavelength-division multiplexing coupler. Backscattered Raman pump light at the first and second wavelengths passes through the first wavelength-division multiplexing coupler and the circulator into a second wavelength division multiplexing coupler. The second wavelength division multiplexing coupler separates the backscattered Raman pump light at the second wavelength from the backscattered Raman pump light at the first wavelength and passes the backscattered Raman pump light at the second wavelength to an optical monitor.

10. With the arrangement defined by claims 1 and 2, my invention allows optical time domain reflectometry measurements to be made using Raman pump lasers that are also used to create Raman gain for normal optical data signals. No additional probe light sources or additional coupling optics are required to make these OTDR measurements. The power of the Raman pump light at both the first and second wavelengths remains above zero to avoid disrupting the optical data signals in the transmission fiber. The second wavelength division multiplexing coupler isolates backscattered light at the second wavelength from backscattered light at the first wavelength, so that OTDR measurements at the second wavelength may be made without interference from backscattered light at the first Raman pump wavelength.

11. The optical data signals that pass through optical amplifier equipment in accordance with claims 1 and 2 of my invention pass through the first wavelength-division-multiplexing coupler, but do not pass through the second wavelength-division-multiplexing coupler. This avoids signal degradation that would be present if the optical data signals had to traverse additional couplers or taps.

12. The use of two cascaded wavelength-division-multiplexing couplers in the optical amplifier equipment in accordance with claims 1 and 2 of my invention allows accurate OTDR measurements at the second wavelength while modulating the Raman gain produced at the second wavelength by the first Raman pump wavelength. Because the first wavelength of light is separated from the second wavelength of light, signals from the first wavelength of light can remain above zero to avoid disrupting normal data traffic in the transmission fiber while simultaneously making measurements of backscattered light at the second wavelength. The first wavelength-division-multiplexing coupler is in the optical data path, but the second wavelength-division-multiplexing coupler is not in the optical data path, which further avoids disrupting the normal data traffic. The beneficial results of using my cascaded two coupler arrangement are unexpected from conventional arrangements of the type shown in Ghera and Park.

13. The Ghera patent shows five possible ways to make measurements on fiber 110 in FIG. 2: (1) using the equipment of box 180, (2) using the equipment of box 170 and pump 120, (3) using the equipment of box 140, (4) using the equipment of box 150/190 and (5) using the equipment of box 160/190. None of this equipment uses the cascaded wavelength-division-multiplexing coupler arrangement of my invention.

14. The equipment in boxes 150/190 and 160/190 of Ghera uses sources 230 and 231 to make measurements, rather than Raman pump light, which requires additional equipment in the form of sources 230 and 231 and couplers 210 and 211. The additional couplers introduce undesirable optical losses in the data signal band.

15. The equipment of box 140 uses a tap 291 to tap a broad spectrum of optical signals from fiber 110. Optical spectrum analysis is performed using OSA 292. The tap introduces losses in the data signal band that degrade the optical data signals.

16. The equipment of box 180 uses an input tap 271 and detector to monitor the total power of the light passing through fiber 110. There is no wavelength selectivity in the taps 271 and 291.

17. The equipment of box 170 provides Raman pump light to fiber 110 from pump unit 120. Wavelength-division-multiplexing coupler 260 and detector 290 can be used to make measurements of

backscattered Raman pump light. However, there is no second coupler attached to circulator 280, so backscattered signals at a second Raman wavelength cannot be separated from backscattered signals at a first Raman wavelength for OTDR measurements. All of the backscattered Raman pump light that is diverted from the fiber 110 by wavelength-division-multiplexing coupler 260 is measured by detector 290, because there is no way to separate backscattered Raman pump light at different wavelengths before it is measured.

18. The Park patent describes a closed-loop Raman pump system with multiple pump wavelengths. FIG. 4 of the Park patent shows how multiple pump lasers 402A, 402B, 402C, and 402D may be modulated using a Raman amplifier control system 401. A tap coupler 420 is used to receive backscattered Raman pump light from fiber 416 at all wavelengths. Like the tap couplers 271 and 291 in Ghera, there is no wavelength selectivity in tap 420 of Park.

19. As set forth in paragraphs 9-18, arrangements in accordance with claims 1 and 2 of my invention use a first wavelength-division-multiplexing coupler to separate backscattered Raman pump light at first and second pump wavelengths from the optical data signal path and use a circulator and second wavelength-division-multiplexing coupler to separate the second wavelength from the first wavelength.

OTDR measurements are made using pulses at the second pump wavelength while the Raman pump light at the first pump wavelength is modulated. This produces OTDR measurement results at the second Raman pump wavelength that cannot be achieved using conventional arrangements such as those of Ghera and Park that do not have cascaded wavelength-division-multiplexing couplers for separating backscattered light at first and second Raman pump wavelengths.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United State Code, and that such willful false statements may jeopardize the validity of this application or any patent issuing thereon.

Chien-Jen Chen

Date July-8, 2004